

SEQUENCE LISTING

<110> Nielsen, Bjarne Roenfeldt
Svendsen, Allan
Pedersen, Henrik
Vind, Jesper
Hendriksen, Hanne Vang
Frandsen, Torben Peter

<120> Glucoamylase Variants

<130> 5636.200-US

<140> 09/351,814

<141> 1999-07-12

<150> PA 1998 00937

<151> 1998-07-15

<150> PA 1998 01667

<151> 1998-12-17

<150> 60/093,528

<151> 1998-07-21

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<151> 1999-01-12

<160> 81

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Leu Ala Asn Val Ile Ser Lys Arg Ala Thr Leu Asp Ser Trp Leu Ser	
-5 1 5	
aac gaa gcg acc gtg gct cgt act gcc atc ctg aat aac atc ggg gcg	144
Asn Glu Ala Thr Val Ala Arg Thr Ala Ile Leu Asn Asn Ile Gly Ala	
10 15 20	
gac ggt gct tgg gtg tcg gcc gcg gac tct ggc att gtc gtt gct agt	192
Asp Gly Ala Trp Val Ser Gly Ala Asp Ser Gly Ile Val Val Ala Ser	
25 30 35 40	

ccc agc acg gat aac ccg gac tac ttc tac acc tgg act cgc gac tct Pro Ser Thr Asp Asn Pro Asp Tyr Phe Thr Trp Thr Arg Asp Ser 45 50 55	240
ggt ctc gtc ctc aag acc ctc gtc gat ctc ttc cga aat gga gat acc Gly Leu Val Leu Lys Thr Leu Val Asp Leu Phe Arg Asn Gly Asp Thr 60 65 70	288
agt ctc ctc tcc acc att gag aac tac atc tcc gcc cag gca att gtc Ser Leu Leu Ser Thr Ile Glu Asn Tyr Ile Ser Ala Gln Ala Ile Val 75 80 85	336
cag ggt atc agt aac ccc tct ggt gat ctg tcc agc ggc gct ggt ctc Gln Gly Ile Ser Asn Pro Ser Gly Asp Leu Ser Ser Gly Ala Gly Leu 90 95 100	384
ggt gaa ccc aag ttc aat gtc gat gag act gcc tac act ggt tct tgg Gly Glu Pro Lys Phe Asn Val Asp Glu Thr Ala Tyr Thr Gly Ser Trp 105 110 115 120	432
gga cgg ccg cag cga gat ggt ccg gct ctg aga gca act gct atg atc Gly Arg Pro Gln Arg Asp Gly Pro Ala Leu Arg Ala Thr Ala Met Ile 125 130 135	480
ggc ttc ggg cag tgg ctg ctt gac aat ggc tac acc agc acc gca acc Gly Phe Gly Gln Trp Leu Leu Asp Asn Gly Tyr Thr Ser Thr Ala Thr 140 145 150	528
gac att gtt tgg ccc ctc gtt agg aac gac ctg tcg tat gtc gct caa Asp Ile Val Trp Pro Leu Val Arg Asn Asp Leu Ser Tyr Val Ala Gln 155 160 165	576
tac tgg aac cag aca gga tat gat ctc tgg gaa gaa gtc aat ggc tcg Tyr Trp Asn Gln Thr Gly Tyr Asp Leu Trp Glu Glu Val Asn Gly Ser 170 175 180	624
tct ttc ttt acg att gct gtg caa cac cgc gcc ctt gtc gaa ggt agt Ser Phe Phe Thr Ile Ala Val Gln His Arg Ala Leu Val Glu Gly Ser 185 190 195 200	672
gcc ttc gcg acg gcc gtc ggc tcg tcc tgc tcc tgg tgt gat tct cag Ala Phe Ala Thr Ala Val Gly Ser Ser Cys Ser Trp Cys Asp Ser Gln 205 210 215	720
gca ccc gaa att ctc tgc tac ctg cag tcc ttc tgg acc ggc agc ttc Ala Pro Glu Ile Leu Cys Tyr Leu Gln Ser Phe Thr Trp Thr Gly Ser Phe 220 225 230	768
att ctg gcc aac ttc gat agc agc cgt tcc ggc aag gac gca aac acc Ile Leu Ala Asn Phe Asp Ser Ser Arg Ser Gly Lys Asp Ala Asn Thr 235 240 245	816
ctc ctg gga agc atc cac acc ttt gat cct gag gcc gca tgc gac gac Leu Leu Gly Ser Ile His Thr Phe Asp Pro Glu Ala Ala Cys Asp Asp 250 255 260	864
tcc acc ttc cag ccc tgc tcc ccg cgc gcg ctc gcc aac cac aag gag Ser Thr Phe Gln Pro Cys Ser Pro Arg Ala Leu Ala Asn His Lys Glu 265 270 275 280	912
gtt gta gac tct ttc cgc tca atc tat acc ctc aac gat ggt ctc agt Val Val Asp Ser Phe Arg Ser Ile Tyr Thr Leu Asn Asp Gly Leu Ser 285 290 295	960
gac agc gag gct gtt gcg gtg ggt cgg tac cct gag gac acg tac tac Asp Ser Glu Ala Val Ala Val Gly Arg Tyr Pro Glu Asp Thr Tyr Tyr	1008

300	305	310	
aac ggc aac ccg tgg ttc ctg tgc acc ttg gct gcc gca gag cag ttg Asn Gly Asn Pro Trp Phe Leu Cys Thr Leu Ala Ala Glu Gln Leu 315 320 325			1056
tac gat gct cta tac cag tgg gac aag cag ggg tcg ttg gag gtc aca Tyr Asp Ala Leu Tyr Gln Trp Asp Lys Gln Gly Ser Leu Glu Val Thr 330 335 340			1104
gat gtg tcg ctg gac ttc ttc aag gca ctg tac agc gat gct gct act Asp Val Ser Leu Asp Phe Phe Lys Ala Leu Tyr Ser Asp Ala Ala Thr 345 350 355 360			1152
ggc acc tac tct tcg tcc agt tcg act tat agt agc att gta gat gcc Gly Thr Tyr Ser Ser Ser Ser Ser Thr Tyr Ser Ser Ile Val Asp Ala 365 370 375			1200
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gca agc aac ggc tcc atg tcc gag caa tac gac aag tct gat gcc gag Ala Ser Asn Gly Ser Met Ser Glu Gln Tyr Asp Lys Ser Asp Gly Glu 395 400 405			1296
cag ctt tcc gct cgc gac ctg acc tgg tct tat gct gct ctg ctg acc Gln Leu Ser Ala Arg Asp Leu Thr Trp Ser Tyr Ala Ala Leu Leu Thr 410 415 420			1344
gcc aac aac cgt cgt aac tcc gtc gtg cct gct tct tgg gcc gag acc Ala Asn Asn Arg Arg Asn Ser Val Val Pro Ala Ser Trp Gly Glu Thr 425 430 435 440			1392
tct gcc agc agc gtg ccc ggc acc tgt gcg gcc aca tct gcc att ggt Ser Ala Ser Ser Val Pro Gly Thr Cys Ala Ala Thr Ser Ala Ile Gly 445 450 455			1440
acc tac agc agt gtg act gtc acc tcg tgg ccg agt atc gtg gct act Thr Tyr Ser Ser Val Thr Val Thr Ser Trp Pro Ser Ile Val Ala Thr 460 465 470			1488
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tcg acc agc aag acc acc gcg act gct agc aag acc agc acc acg acc Ser Thr Ser Lys Thr Thr Ala Thr Ala Ser Lys Thr Ser Thr Thr Thr 490 495 500			1584
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 <212> PRT
 <213> *Aspergillus niger*

<220>
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 <222> (1)...(24)

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 Asn Glu Ala Thr Val Ala Arg Thr Ala Ile Leu Asn Ile Gly Ala
 10 15 20
 Asp Gly Ala Trp Val Ser Gly Ala Asp Ser Gly Ile Val Val Ala Ser
 25 30 35 40
 Pro Ser Thr Asp Asn Pro Asp Tyr Phe Tyr Thr Trp Thr Arg Asp Ser
 45 50 55
 Gly Leu Val Leu Lys Thr Leu Val Asp Leu Phe Arg Asn Gly Asp Thr
 60 65 70
 Ser Leu Leu Ser Thr Ile Glu Asn Tyr Ile Ser Ala Gln Ala Ile Val
 75 80 85
 Gln Gly Ile Ser Asn Pro Ser Gly Asp Leu Ser Ser Gly Ala Gly Leu
 90 95 100
 Gly Glu Pro Lys Phe Asn Val Asp Glu Thr Ala Tyr Thr Gly Ser Trp
 105 110 115 120
 Gly Arg Pro Gln Arg Asp Gly Pro Ala Leu Arg Ala Thr Ala Met Ile
 125 130 135
 Gly Phe Gly Gln Trp Leu Leu Asp Asn Gly Tyr Thr Ser Thr Ala Thr
 140 145 150
 Asp Ile Val Trp Pro Leu Val Arg Asn Asp Leu Ser Tyr Val Ala Gln
 155 160 165
 Tyr Trp Asn Gln Thr Gly Tyr Asp Leu Trp Glu Glu Val Asn Gly Ser
 170 175 180
 Ser Phe Phe Thr Ile Ala Val Gln His Arg Ala Leu Val Glu Gly Ser
 185 190 195 200
 Ala Phe Ala Thr Ala Val Gly Ser Ser Cys Ser Trp Cys Asp Ser Gln
 205 210 215
 Ala Pro Glu Ile Leu Cys Tyr Leu Gln Ser Phe Trp Thr Gly Ser Phe
 220 225 230
 Ile Leu Ala Asn Phe Asp Ser Ser Arg Ser Gly Lys Asp Ala Asn Thr
 235 240 245
 Leu Leu Gly Ser Ile His Thr Phe Asp Pro Glu Ala Ala Cys Asp Asp
 250 255 260
 Ser Thr Phe Gln Pro Cys Ser Pro Arg Ala Leu Ala Asn His Lys Glu
 265 270 275 280
 Val Val Asp Ser Phe Arg Ser Ile Tyr Thr Leu Asn Asp Gly Leu Ser
 285 290 295
 Asp Ser Glu Ala Val Ala Val Gly Arg Tyr Pro Glu Asp Thr Tyr Tyr
 300 305 310
 Asn Gly Asn Pro Trp Phe Leu Cys Thr Leu Ala Ala Glu Gln Leu
 315 320 325
 Tyr Asp Ala Leu Tyr Gln Trp Asp Lys Gln Gly Ser Leu Glu Val Thr
 330 335 340
 Asp Val Ser Leu Asp Phe Phe Lys Ala Leu Tyr Ser Asp Ala Ala Thr
 345 350 355 360
 Gly Thr Tyr Ser Ser Ser Ser Ser Thr Tyr Ser Ser Ile Val Asp Ala
 365 370 375
 Val Lys Thr Phe Ala Asp Gly Phe Val Ser Ile Val Glu Thr His Ala
 380 385 390
 Ala Ser Asn Gly Ser Met Ser Glu Gln Tyr Asp Lys Ser Asp Gly Glu
 395 400 405
 Gln Leu Ser Ala Arg Asp Leu Thr Trp Ser Tyr Ala Ala Leu Leu Thr
 410 415 420
 Ala Asn Asn Arg Arg Asn Ser Val Val Pro Ala Ser Trp Gly Glu Thr
 425 430 435 440
 Ser Ala Ser Ser Val Pro Gly Thr Cys Ala Ala Thr Ser Ala Ile Gly
 445 450 455
 Thr Tyr Ser Ser Val Thr Val Thr Ser Trp Pro Ser Ile Val Ala Thr
 460 465 470
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 475 480 485
 Ser Thr Ser Lys Thr Thr Ala Thr Ala Ser Lys Thr Ser Thr Thr Thr
 490 495 500
 Arg Ser Gly Met Ser Leu
 505 510

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 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Primer 7258

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 <210> 4
 <211> 68
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Primer 21401

 <400> 4
 ggggatcatg ataggactag ccatattaat gaagggcata taccacgcct tggacctgag 60
 ttatagcc 68

 <210> 5
 <211> 25
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Primer 107581

 <400> 5
 gcaacgaagc gcccgtagct cgtac 25

 <210> 6
 <211> 88
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Primer FAMGIL

 <400> 6
 cgaagcgacc gtggctcgta ctgccatcta taacatcgcc gcgtctgtgc gcgggtggcat 60
 tgtcgttgct agtccacgca cggataac 88

 <210> 7
 <211> 28
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> Primer RAMG1

 <400> 7
 gatggcagta cgagccacgg tcgcttcg 28

 <210> 8
 <211> 75
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> PRIMER FAMGIV

 <400> 8
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gaagactttc gccga

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<210> 9
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<212> DNA
<213> PRIMER RAMGVI

<400> 9
cttgaagaag tcacgcgaca c

21

<210> 10
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer FG2

<400> 10
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27

<210> 11
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Primer RG2

<400> 11
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27

<210> 12
<211> 2602
<212> DNA
<213> ASPERGILLUS NIGER

<400> 12
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ctttctctct cagcttcccc tcgtgcgagt gagggtttggc tataaatgtg agtggtttggt 180
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 atccggaaat acagcacacc gg 2602

<210> 13
 <211> 640
 <212> PRT
 <213> ASPERGILLUS NIGER

<400> 13

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 35 40 45
 Asp Gly Ala Trp Val Ser Gly Ala Asp Ser Gly Ile Val Val Ala Ser
 50 55 60
 Pro Ser Thr Asp Asn Pro Asp Tyr Phe Tyr Thr Trp Thr Arg Asp Ser
 65 70 75 80
 Gly Leu Val Leu Lys Thr Leu Val Asp Leu Phe Arg Asn Gly Asp Thr
 85 90 95
 Ser Leu Leu Ser Thr Ile Glu Asn Tyr Ile Ser Ala Gln Ala Ile Val
 100 105 110
 Gln Gly Ile Ser Asn Pro Ser Gly Asp Leu Ser Ser Gly Ala Gly Leu
 115 120 125
 Gly Glu Pro Lys Phe Asn Val Asp Glu Thr Ala Tyr Thr Gly Ser Trp
 130 135 140
 Gly Arg Pro Gln Arg Asp Gly Pro Ala Leu Arg Ala Thr Ala Met Ile
 145 150 155 160
 Gly Phe Gly Gln Trp Leu Leu Asp Asn Gly Tyr Thr Ser Thr Ala Thr
 165 170 175
 Asp Ile Val Trp Pro Leu Val Arg Asn Asp Leu Ser Tyr Val Ala Gln
 180 185 190
 Tyr Trp Asn Gln Thr Gly Tyr Asp Leu Trp Glu Glu Val Asn Gly Ser
 195 200 205
 Ser Phe Phe Thr Ile Ala Val Gln His Arg Ala Leu Val Glu Gly Ser
 210 215 220
 Ala Phe Ala Thr Ala Val Gly Ser Ser Cys Ser Trp Cys Ser Gln
 225 230 235 240
 Ala Pro Glu Ile Leu Cys Tyr Leu Gln Ser Phe Trp Thr Gly Ser Phe
 245 250 255
 Ile Leu Ala Asn Phe Asp Ser Ser Arg Ser Gly Lys Asp Ala Asn Thr
 260 265 270
 Leu Leu Gly Ser Ile His Thr Phe Asp Pro Glu Ala Ala Cys Asp Asp
 275 280 285
 Ser Thr Phe Gln Pro Cys Ser Pro Arg Ala Leu Ala Asn His Lys Glu
 290 295 300
 Val Val Asp Ser Phe Arg Ser Ile Tyr Thr Leu Asn Asp Gly Leu Ser
 305 310 315 320
 Asp Ser Glu Ala Val Ala Val Gly Arg Tyr Pro Glu Asp Thr Tyr Tyr
 325 330 335
 Asn Gly Asn Pro Trp Phe Leu Cys Thr Leu Ala Ala Ala Gln Leu
 340 345 350
 Tyr Asp Ala Leu Tyr Gln Trp Asp Lys Gln Gly Ser Leu Glu Val Thr

355 360 365
 Asp Val Ser Leu Asp Phe Phe Lys Ala Leu Tyr Ser Asp Ala Ala Thr
 370 375 380
 Gly Thr Tyr Ser Ser Ser Ser Thr Tyr Ser Ser Ile Val Asp Ala
 385 390 395 400
 Val Lys Thr Phe Ala Asp Gly Phe Val Ser Ile Val Glu Thr His Ala
 405 410 415
 Ala Ser Asn Gly Ser Met Ser Glu Gln Tyr Asp Lys Ser Asp Gly Glu
 420 425 430
 Gln Leu Ser Ala Arg Asp Leu Thr Trp Ser Tyr Ala Ala Leu Leu Thr
 435 440 445
 Ala Asn Asn Arg Arg Asn Ser Val Val Pro Ala Ser Trp Gly Glu Thr
 450 455 460
 Ser Ala Ser Ser Val Pro Gly Thr Cys Ala Ala Thr Ser Ala Ile Gly
 465 470 475 480
 Thr Tyr Ser Ser Val Thr Val Thr Ser Trp Pro Ser Ile Val Ala Thr
 485 490 495
 Gly Gly Thr Thr Thr Ala Thr Pro Thr Gly Ser Gly Ser Val Thr
 500 505 510
 Ser Thr Ser Lys Thr Thr Ala Thr Ala Ser Lys Thr Ser Thr Ser Thr
 515 520 525
 Ser Ser Thr Ser Cys Thr Thr Pro Thr Ala Val Ala Val Thr Phe Asp
 530 535 540
 Leu Thr Ala Thr Thr Thr Tyr Gly Glu Asn Ile Tyr Leu Val Gly Ser
 545 550 555 560
 Ile Ser Gln Leu Gly Asp Trp Glu Thr Ser Asp Gly Ile Ala Leu Ser
 565 570 575
 Ala Asp Lys Tyr Thr Ser Ser Asp Pro Leu Trp Tyr Val Thr Val Thr
 580 585 590
 Leu Pro Ala Gly Glu Ser Phe Glu Tyr Lys Phe Ile Arg Ile Glu Ser
 595 600 605
 Asp Asp Ser Val Glu Trp Glu Ser Asp Pro Asn Arg Glu Tyr Thr Val
 610 615 620
 Pro Gln Ala Cys Gly Thr Ser Thr Ala Thr Val Thr Asp Thr Trp Arg
 625 630 635 640

<210> 14
 <211> 43
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer K1-T2X
 n at positions 22 and 23 is a or g or c or t

<400> 14
 atgtgatttc caagcgcg vnnattggatt catggttgag caa 43

<210> 15
 <211> 43
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk1-N9X
 n at positions 22 and 23 is a or g or c or t

<400> 15
 ccttgatttc atgggtgagc vnngaagcga ccgtggctcg tac 43

<210> 16
 <211> 43
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk1-A11X

n at positions 22 and 23 is a o r g o r c o r t

<400> 16
attcatgtgt gagcaacgaa vnnaccgtgg ctogtactgc cat 43

<210> 17
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk1-L66X
n at positions 22 and 23 is a o r g o r c o r t

<400> 17
tcctcaagac cctcgtcgat vnnctccgaa atggagatag cag 43

<210> 18
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk1-S386X
n at positions 22 and 23 is a o r g o r c o r t

<400> 18
cttccgcga tggcttcgtc vnnattgtgg aaactcacgc cgc 43

<210> 19
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk1-E389X
n at positions 22 and 23 is a o r g o r c o r t

<400> 19
atgggttcgt ctctattgtg vnnactcacg ccgcaagcaa cgg 43

<210> 20
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk1-T390X
n at positions 22 and 23 are a o r g o r c

<400> 20
gcttcgtctc tattgtggaa vnnacgccc caagcaacgc ctc 43

<210> 21
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk1-A393X
n at positions 22 and 23 is a o r g o r c o r t

<400> 21
ctattgtgga aactcacgc vnnagcaacg gctccatgtc cga 43

<210> 22
<211> 43

<212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-S394X
 n at positions 22 and 23 is a or g or c or t

 <400> 22
 ttgtggaac tcacgccgca vnnaacggct ccatgtccga gca 43

 <210> 23
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 <212> DNA
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 <220>
 <223> primer Hk1-395X
 n at positions 22 and 23 is a or g or c or t

 <400> 23
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 <210> 24
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-G396X
 n at positions 22 and 23 is a or g or c or t

 <400> 24
 aaactcacgc cgcaagcaac vnntccatgt ccgagcaata cga 43

 <210> 25
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-K404X
 n at positions 22 and 23 is a or g or c or t

 <400> 25
 ccatgtccga gcaatacgac vnntctgatg gcgagcagct ttc 43

 <210> 26
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-D406X
 n at positions 22 and 23 is a or g or c or t

 <400> 26
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 <210> 27
 <211> 43
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk1-E408X
 n at positions 22 and 23 is a or g or c or t

<400> 27
 aatacgacaa gtctgatggc vnnacgcttt cgctcgga cct 43
 <210> 28
 <211> 42
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 <223> primer Hk1-L410X
 n at positions 22 and 23 is a or g or c or t
 <400> 28
 acaagtctga tggcgagcag vnnctcgctc ggcacctgac ct 42
 <210> 29
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-L423X
 n at positions 22 and 23 is a or g or c or t
 <400> 29
 cctggtctta tgcgtctctg vnnaccgcca acaaccgtcg taa 43
 <210> 30
 <211> 44
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-N426X
 n at positions 22 and 23 is a or g or c or t
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 <210> 31
 <211> 44
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-N427X
 n at positions 22 and 23 is a or g or c or t
 <400> 31
 ctgctctgct gacgcgaac vnnctcgta actccgtcgt gcct 44
 <210> 32
 <211> 46
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk1-Y402X
 n at positions 21 and 22 is a or g or c or t
 <400> 32
 acggctccat gtccgagcaa nncgacaagt ctgatggcga gcagct 46
 <210> 33
 <211> 41
 <212> DNA

<213> Artificial Sequence
 <220>
 <223> primer Hk2-L234X-sense
 n at positions 20 and 21 is a or g or c or t
 <400> 33
 ctggaccggc agcttcattn nkgccaactt cगतगगग c 41
 <210> 34
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-A235S-antisense
 <400> 34
 gaacggctgc tatcgaaagt agacagaatg aagctgccgg tc 42
 <210> 35
 <211> 41
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-NF237X-sense
 n at position 20 is a or g or c or t
 <400> 35
 cagcttcatt ctggccaacn atगतगगग cगgttcggc a 41
 <210> 36
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-D235T-antisense
 <400> 36
 ccttgccgga acggctgcta gtgaagttgg ccagaatgaa gc 42
 <210> 37
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-D238S-antisense
 <400> 37
 cottgccgga acggctgcta gagaagttgg ccagaatgaa gc 42
 <210> 38
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk2-S239X-sense
 n at positions 21 and 22 is a or g or c or t
 <400> 38
 tcattctggc caacttcgat nncagcggtt cggcaagga cg 42

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<210> 39
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-S240G-antisense

<400> 39
ttgcgtccctt gccggaacga ccgctatcga agttggccag aa      42

<210> 40
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-S242X-antisense
      n at position 22 is a or g or c or t

<400> 40
gggtgtttgc gtccttgcca knacggctgc tatcgaagtt g      41

<210> 41
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-G243X-antisense
      n at position 22 is a or g or c or t

<400> 41
ggagggtggtt tgcgtccotta knngaacggc tgctatcgaa g      41

<210> 42
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-K244R-sense

<400> 42
cgatagcagc cgttccggca gagacgcaaa caccctcctg g      41

<210> 43
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-T310V-antisense

<400> 43
acgggttgcc gttgtagtaa acgtcctcag ggtaccgacc c      41

<210> 44
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-T310S-antisense

<400> 44

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acgggttgcc gttgtagtaa gagtccctcag ggtaccgacc c 41

<210> 45
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-Y311N-sense

<400> 45
tcggtagcct gaggacacga attacaacgg caaccgtgg t 41

<210> 46
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> Hk2-Y312Q-antisense

<400> 46
ggaaccacgg gttgccgttt ttgtacgtgt cctcagggta c 41

<210> 47
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-Y312N-antisense

<400> 47
ggaaccacgg gttgccgtta ttgtacgtgt cctcagggta c 41

<210> 48
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-N313T-sense

<400> 48
ccctgaggac acgtactaca ctggcaaccc gtggttcctg t 41

<210> 49
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk2-N313S-sense

<400> 49
ccctgaggac acgtactact ctggcaaccc gtggttcctg t 41

<210> 50
<211> 41
<212> DNA
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<220>
<223> primer Hk2-N313G-sense

<400> 50
ccctgaggac acgtactacg gtggcaaccc gtggttcctg t 41

<210> 51
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-N315Q-antisense

 <400> 51
 aggtgcacag gaaccacggt tggccgttgt agtacgtgtc c 41

 <210> 52
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-N315E-antisense

 <400> 52
 aggtgcacag gaaccacggt tcgccgttgt agtacgtgtc c 41

 <210> 53
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-N315R-antisense

 <400> 53
 aggtgcacag gaaccacggt ctgccgttgt agtacgtgtc c 41

 <210> 54
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-F318Y-antisense

 <400> 54
 cggcagccaa ggtgcacaga taccacgggt tggcgttgta g 41

 <210> 55
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk2-Q409P-sense

 <400> 55
 cgacaagtct gatggcgagc cactttccgc tcgcgacctg a 41

 <210> 56
 <211> 41
 <212> DNA
 <213> Artificial Sequence

 <220>
 <223> primer Hk3-D336X-sense
 n at positions 20 and 21 is a or g or c or t

 <400> 56
 cgatgctcta taccagtggg nkaagcaggg gtcgttgagg g 41

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<210> 57
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-K337X-sense
      n at positions 20 and 21 is a or g or c or t

<400> 57
tgctctatac cagtgaggacn nkcaggggtc gttggaggtc a      41

<210> 58
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-Q338X-antisense
      n at positions 21 and 22 is a or g or c or t

<400> 58
ctgtgacctc caacgaccog nncctgtgcc actggtatag a      41

<210> 59
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-G339X-sense
      n at position 20 is a or g or c or t

<400> 59
ataccagtg gacaagcagn cutcgttgga ggtoacagat g      41

<210> 60
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S340X'-antisense
      n at position 21 is a or g or c or t

<400> 60
acacatctgt gacctccaaa ntcccctgct tgtcccactg g      41

<210> 61
<211> 41
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S340X"-antisense
      n at position 21 is a or g or c or t

<400> 61
acacatctgt gacctccaaa ncccctgct tgtcccactg g      41

<210> 62
<211> 41
<212> DNA
<213> Artificial Sequence

<220>

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<223> primer Hk3-L341X-sense
 n at position 20 is a o r g o r c o r t

<400> 62
 gtgggacaag caggggtcgn uugaggtcac agatgtgtcg c 41

<210> 63
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-K352Q-sense

<400> 63
 tgtgtcgtcg gacttcttcc aagcactgta cagcgatgct g 41

<210> 64
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-K352R-sense

<400> 64
 tgtgtcgtcg gacttcttca gagcactgta cagcgatgct g 41

<210> 65
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-A352D-antisense

<400> 65
 tagcagcatc gctgtacaga tcottgaaga agtccagcga c 41

<210> 66
 <211> 41
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer HK3-A353S-antisense

<400> 66
 tagcagcatc gctgtacaga gacttgaaga agtccagcga c 41

<210> 67
 <211> 42
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> primer Hk3-3356P-sense

<400> 67
 acttcttcaa ggcactgtac ccagatgctg ctactggcac ct 42

<210> 68
 <211> 43
 <212> DNA
 <213> Artificial Sequence

<220>

<223> primer Hk3-S356N-sense
 <400> 68
 acttcttcaa ggcactgtac aaugatgctg ctactggcac cta 43
 <210> 69
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-S356D-sense
 <400> 69
 acttcttcaa ggcactgtac gaugatgctg ctactggcac cta 43
 <210> 70
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-D357S-antisense
 <400> 70
 gagtaggtgc cagtagcagc agagctgtac agtgccttga aga 43
 <210> 71
 <211> 41
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-A359S-sense
 <400> 71
 ggcactgtac agcgatgctt ctactggcac ctactcttcg t 41
 <210> 72
 <211> 41
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-T360V-antisense
 <400> 72
 tggacgaaga gtaggtgcca acagcagcat cgctgtacag t 41
 <210> 73
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-G361X-sense
 n at position 21 is a o r g o r c o r t
 <400> 73
 tgtacagcga tgctgtact nctacctact ctctgtccag ttc 43
 <210> 74
 <211> 42
 <212> DNA
 <213> Artificial Sequence
 <220>

<223> primer Hk3-T362R-antisense

<400> 74
gtcgaactgg acgaagagta tctgccagta gcagcatcgc tg 42

<210> 75
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S364X-sense
n at positions 20 and 21 is a or g or c or t

<400> 75
tgctgctact ggcacctach nktcgccag ttcgacttat ag 42

<210> 76
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S365X-sense
n at positions 20 and 21 is a or g or c or t

<400> 76
tgctactggc acctactctn nktccagttc gacttatagt ag 42

<210> 77
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S366T-antisense

<400> 77
atgctactat aagtcgaact agtcgaagag taggtgccag ta 42

<210> 78
<211> 42
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-S368X-antisense
n at position 23 is a or g or c or t

<400> 78
tctacaatgc tactataagt agnactggac gaagagtagg tg 42

<210> 79
<211> 43
<212> DNA
<213> Artificial Sequence

<220>
<223> primer Hk3-T369X-sense
n at positions 20 and 21 is a or g or c or t

<400> 79
ctactcttcg tccagttcgn nktatagtag cattgtagat gcc 43

<210> 80
<211> 43

<212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-S371X-antisense
 n at position 23 is a or g or c or t
 <400> 80
 ttcacggcat ctacaatgct atnataagtc gaactggacg aag 43
 <210> 81
 <211> 43
 <212> DNA
 <213> Artificial Sequence
 <220>
 <223> primer Hk3-S372X-sense
 n at positions 21 and 22 is a or g or c or t
 <400> 81
 cgtccagttc gacttatagt nntattgtag atgccgtgaa gac 43